KEITHLEY

Model 35035
Instruction Manual

Contains Operation and Maintenance Information for the Model 35035 mA/mAs Meter

Manual No. 37549IM
Revision A, November 1989

WARRANTY

Keithley Instruments, Inc. warrants this product to be free from defects in material and workmanship for a period of 1 year from date of shipment. During the warranty period, we will, at our option, either repair or replace any product that proves to be defective.

To exercise this warranty, write or call your local Keithley representative, or contact Keithley headquarters in Cleveland, Ohio. You will be given prompt assistance and return instructions. Send the instrument, transportation prepaid, to the indicated service facility. Repairs will be made and the instrument returned, transportation prepaid. Repaired products are warranted for the balance of the original warranty period, or at least 90 days.

LIMITATION OF WARRANTY

This warranty does not apply to defects resulting from unauthorized modification or misuse of any product or part. This warranty also does not apply to fuses, batteries, or damage from battery leakage.

This warranty is in lieu of all other warranties, expressed or implied, including any implied warranty of merchantability or fitness for a particular use. Keithley Instruments, Inc. shall not be liable for any indirect, special or consequential damages.

KEITHLEY

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Model 35035 mA/mAs Meter

Keithley Radiation Measurements Division
Keithley Instruments, Inc.
Revision A, November 1989
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Section 1
SPECIFICATIONS

1.1 Specifications

CURRENT (mA)		
Range	Resolution	Input Impedance*
20 mA	0.01 mA	100 Ohms
200 mA	0.1 mA	10 Ohms
2000 mA	1 mA	1 Ohm

MILLIAMP SECONDS (mAs)			
Range	Resolution	Threshhold Current	Input Impedance*
200 mAs	0.1 mAs	3.2 mA	10 Ohms
2000 mAs	1 mAs	32 mA	1 Ohm

* Does not include fuse resistance or effect of bridge rectifier present when unit is set for AC.

SIGNAL INPUT LIMITS					
Function	Range	Maximum Input Limit	Function	Range	Maximum Input Limit
mA	OFF	Input shorted -2.0 A max. (fuse protected)	mAs	20	Input shorted - 2.0 A max (fuse protected)
	20	250 mA for 30 sec.*		200	1 A for 30 sec.*
	200	1 A for 30 sec.*		2000	2.0 A max. (fuse protected)
	2000	2.0 A max. (fuse protected)			

* Limit set by power dissipation rating of shunt resistors. Maximum common mode voltage is 500 V.

GENERAL

Meter Accuracy: ±1% of rdg + 2d on all ranges.

Battery Type: Eveready type 522 or equivalent.

Battery Life: Approximately 300 hours.

Display: 3-1/2 digit LCD; low battery annunciator, 0.50 in. high digits.

Test Leads: 91.4 cm (36 in.) safety set with finger guards on probes and shrouded banana plugs.

Input Jacks: Touch - protected 4 mm banana.

Fuse: 2 A 250 V 3 AG normal-blo littlefuse 312002 or equivalent.

Environmental:
Operating Temperature: 5°C to 35°C
Storage Temperature: -20°C to 50°C
Humidity: 0 to 80%

Dimensions and Weight: 15 cm w. x 5.0 cm d. x 8.75 cm h. (6 in. x 2 in. x 3-1/2 in.); 0.35 kg (0.78 lb.)

Specifications subject to change without notice.
10/89

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Section 2

SAFETY INFORMATION

2.1 Introduction

The following safety precautions should be observed before and while operating the Model 35035. They must be observed in conjunction with those outlined in the manual for the X-ray generator to which the instrument is connected.

Circuit protection provisions are built into the Model 35035. However, they primarily protect the meter circuit itself. The X-ray generator must therefore contain voltage and current limiting components within its circuitry for its own protection as well as for the safety of the technician or operator making the connections to and performing the tests on the generator.

2.2 Safety Precautions

This instrument is intended for use by qualified personnel who recognize shock hazards and are familiar with the safety precautions required to avoid possible injury. Read this manual carefully before operating the Model 35035 mA/mAs Meter.

Exercise extreme caution when a shock hazard is present at the instrument's input. The American National Standards institute (ANSI) states that a shock hazard exists when voltage levels greater than 30 V RMS or 42.4 V Peak are present. A good safety practice is to expect that a hazardous voltage is present in any unknown circuit before measuring.

Do not exceed 500 V peak between input low and earth ground.

Inspect the test leads for possible wear, cracks, or breaks before each use. If any defects are found, replace the test leads with ones which have a reputable measure of safety. For optimum safety, do not touch the test leads or the instrument while power is applied to the circuit under test. Turn the X-ray generator power off before connecting or disconnecting the instrument.

Do not exceed the instrument's maximum allowable input as defined in the Specifications and Operation sections.

2.2 **Safety Precautions** (continued)

The symbol on the instrument indicates that a potential shock hazard may exist during use.

Always expect a shock hazard at the input terminals when the unit is connected to the X-ray generator and the generator is powered.

Do not make any contact with the unit during exposures. The voltage potential at the input could exceed the insulating capacity of the case and test leads under fault conditions.

Section 3
GENERAL INFORMATION

3.1 Introduction

The purpose of this manual is to outline the operation and maintenance of the instrument. IT IS THE RESPONSIBILITY OF THE USER TO DETERMINE THE SUITABILITY OF THIS PRODUCT FOR HIS PARTICULAR MEASUREMENT CONDITIONS. The entire manual should be read before using the meter.

WARNING

Failure to observe all of the safety precautions presented in section 2.2 of this manual as well as those provided by the X-ray generator manufacturer may result in serious injury.

The Keithley Model 35035 mA/mAs Meter has two functions: an mA function with three (3) ranges that measures current in mA, and an mAs function with two (2) ranges that connects an integrator to read the product of current and time in mA-seconds. Both range and function are selected using rotary switches. Either DC or AC input mode is selected using a two-position rocker switch. The mAs function is reset by means of a momentary push-button switch.

Operation of the meter requires a standard 9 V akaline battery. A low-battery warning appears in the display when the battery is nearly depleted (7.2 V). Polarity is displayed as well. Blanking of display digits indicates overrange.

A schematic of the input circuit of the Model 35035 is shown on the following page. R1, R2, and R3 are current shunt resistors for range scaling and changing the input current flow into a voltage. F1, R15, D2, and D3 are input protection devices that protect the shunt resistors and input circuit electronics from excessive current and voltage. F1 is a 2 A, 250 V fuse that limits the input current. R15 is a 140 V varistor that clamps high voltage pulses. D2 and D3 are 24 V zener diodes that clamp lower voltages.

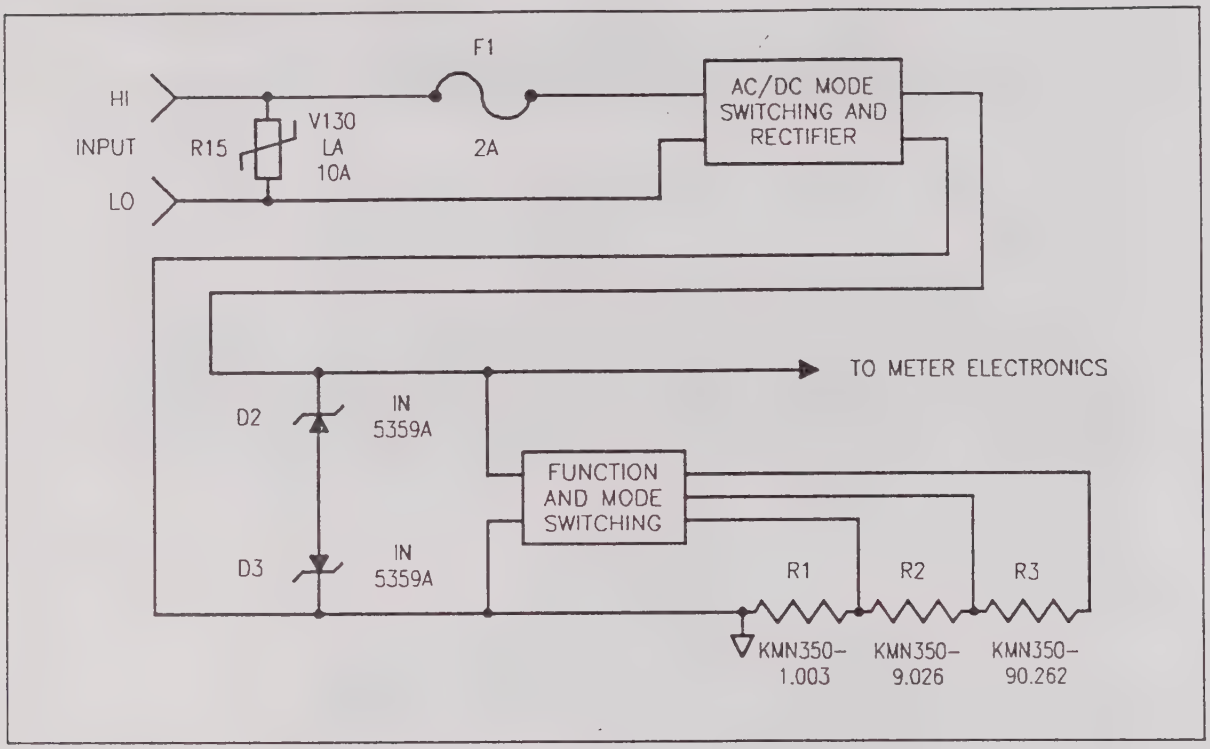

Figure 3-1. Input circuit schematic.

3.2 Instrument Features

Figure 3-2 represents a front panel of the Model 35035 and shows the location of its display, input jacks, fuse, switches, and trimmer adjustment controls. The functions of these features are described below.

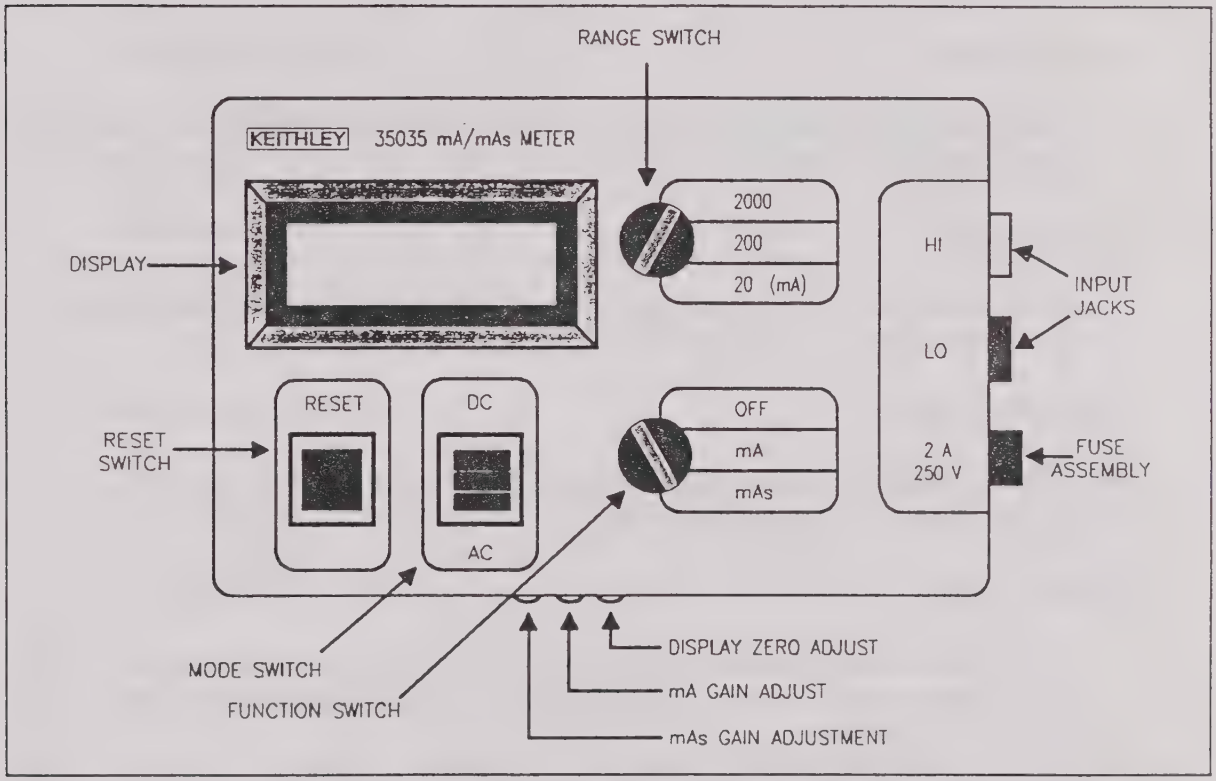

Figure 3-2. Meter front panel.

Input Jacks

Touch-protected 4mm laboratory banana jacks for the use of safety laboratory leads and all spring-loaded 4mm banana plugs.

Fuse Assembly

Allows field replacement of the 2 A, 250 V, 3AG input current protection fuse with a small flat-blade screwdriver.

3.2 **Instrument Features** (continued)

Display

3-1/2 digit liquid crystal display indicates the measured value of the signal applied to the input in mA or mAs.

RESET Switch

Resets the display to zero after an mAs measurement has been made and the display reading has been recorded.

MODE Switch

Selects either AC or DC measurement mode. The position of this switch depends upon the type of current signal from the X-ray generator to be measured.

FUNCTION Switch

Turns the Model 35035 mA/mAs Meter power ON and selects the desired measurement function (mA or mAs).

RANGE Switch

Selects the full-scale measurement range of the Model 35035 (20, 200, or 2000). All three ranges operate in the mA function. Only the 200 and 2000 ranges operate in the mAs function.

Display Zero Adjust

Trimmer potentiometer (R33) provides adjustment for a zero display reading with no signal applied to the input jacks.

mA Gain Adjust

Trimmer potentiometer (R10) provides calibration adjustment of the mA function.

mAs Gain Adjust

Trimmer potentiometer (R7) provides calibration adjustment of the mAs function.

Section 4
OPERATION

4.1 Battery Installation

The Model 35035 mA/mAs Meter is shipped from the factory with the battery separate from the unit. Remove the battery compartment cover on the bottom of the unit to install the battery. Make certain that the battery's clip end is inserted at the end of the compartment where the clip wires come out from the case and that the wires get looped around the top of the battery. This method will aid the user in replacing the battery when its life has been depleted.

4.2 Operating Instructions

1. Before making any connections to the X-ray generator, **MAKE CERTAIN THAT THE GENERATOR'S POWER IS TURNED OFF.** Connect the Model 35035 to the X-ray generator under test. Ensure that the test leads have no defects and the connections are secure.

WARNING

Failure to observe all of the safety precautions presented in section 2.2 of this manual as well as those provided by the X-ray generator manufacturer may result in serious injury.

2. Select either the AC or DC measurement mode on the Model 35035 using the MODE rocker switch depending upon the type of input signal expected from the X-ray generator. Again, knowledge of the signal from a specific generator is the responsibility of the technician.

3. Select the desired measurement function (mA or mAs) on the Model 35035 with the FUNCTION rotary switch. This switch turns the unit's power ON as well.

4.2 Operating Instructions (continued)

4. Select the desired range of the Model 35035 with the RANGE rotary switch. For greatest accuracy in the mA function, select the range which provides the most resolution on the unit's display. (Make certain that the signal input limits specified for that particular range are not exceeded.)

   For mAs readings, select either the 200 range or the 2000 range (the 20 range is for mA only) and when necessary, reset the Model 35035 integrator by depressing the RESET button. Since noise comparators are built into the Model 35035 mAs circuitry, a minimum current of approximately 3.2 mA on the 200 mAs range or 32 mA on the 2000 mAs range is required before the signal registers on the display.

   For greatest accuracy in the mAs function, use as high a current as possible within the proper signal limits for the selected range. The duration of the current pulse should be correspondingly short. This is especially important when measuring mAs in AC mode for single-phase X-ray generators.

5. Turn the X-ray generator power ON and proceed to take measurements with the Model 35035. It is mandatory to **OBSERVE ALL SAFETY PRECAUTIONS** contained in Section 2 of this manual.

6. Turn the X-ray generator power OFF after the measurements are complete.

7. Turn the Model 35035 power OFF and disconnect the test leads.

4.3 Signal Input Limits

WARNING

Exceeding the maximum input overload limits may result in fuse or other component failure. Such failure can result in the generation of dangerously high voltage at the input.

4.3 Signal Input Limits (continued)

Function	Ranges	Maximum Input Limit
	OFF	Input shorted 2 A max (fuse protected).
mA	20	250 mA for 30 sec.*
	200	1 A for 30 sec.*
	2000	2 A max. (fuse protected).
mAs	20	Input shorted 2 A max (fuse protected).
	200	1 A for 30 sec.*
	2000	2 A max (fuse protected).

* Limit set by power dissipation rating of current range shunt resistors.

WARNING

A possible electrical shock hazard may occur if either input terminal is connected to a source of more than 500V DC or RMS AC above earth ground.

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Section 5
MAINTENANCE

5.1 General

The Keithley Model 35035 mA/mAs Meter is designed to perform with an accuracy of 1%. The performance of the meter should be checked periodically to ensure accurate, reliable operation. Under normal operating conditions, this instrument will perform to specifications for a period of at least one (1) year after calibration. The calibration cycle is, therefore, one (1) year. Any major, abrupt changes in performance indicate that the meter might not be operating properly. The unit should then be returned to the factory for repair and calibration. There are no user-serviceable parts within the meter. See Section 5.7 for factory service information.

The calibration procedure for a normal operating unit does not require any disassembly of the instrument. Adjustments are all accessible from the enclosure exterior. They are set using a small flat-blade screwdriver with an insulated handle or an adjustment tool specifically designed for trimmer potentiometer adjustment purposes. Refer to Figure 3-2 for the exact location of the trimmer potentiometer access holes.

5.2 Test Equipment

A calibrated DC current source is required to properly calibrate the Model 35035 mA/mAs Meter. Its dwell time should be adjustable from 100 mS to 10 s and accurate to within 0.5%. Its current output should be adjustable from 1 mA to 2 A and accurate to within 0.5%. Finally, its compliance (burden) voltage should be adjustable to 25 volts DC.

In addition, a precision digital multimeter (0.25% accuracy in DC Amps) can be in the circuit to monitor the output of the current source.

5.3 Performance Tests

Connect the Model 35035 to the current source with appropriate test leads. Place its mode switch in the DC position. For the mA performance tests, apply the current listed and verify that the Model 35035 display reads within the limits specified. For the mAs performance tests, apply the current for the dwell time specified and verify that the Model 35035 display reads within the limits listed. Reversing the polarity of the current source signal should reverse the polarity indicated on the Model 35035 display without significantly altering the numeric value for either mA or mAs. On mAs, the reading generated by a 50 mA, 5 s pulse should be effectively nulled out by an equal pulse of reverse polarity. (Note that except when performing the mAs tracking test, the RESET button must be depressed after each measurement reading.)

5.3.1 mA Performance Tests

35035 Range Setting	Current Source Output	35035 Display Reading
20	5 mA	4.95 - 5.05
20	15 mA	14.85 - 15.15
200	50 mA	49.5 - 50.5
200	150 mA	148.5 - 151.5
2000	500 mA	495 - 505
2000	1500 mA	1485 - 1515

5.3.2 mAs Performance Tests

35035 Range Setting	Current Source Output	Current Source Dwell Time	35035 Display Reading
20	15 mA	1 s	0.00
200	50 mA	1 s	49.5 - 50.5
200	500 mA	.1 s	49.5 - 50.5
200	1500 mA	.1 s	148.5 - 151.5
2000	50 mA	5 s	248 - 253
2000	500 mA	1 s	495 - 505
2000	1500 mA	1 s	1485 - 1515

Note: The following test will verify the mAs tracking performance. Do not depress the RESET button between applied current pulses.

2000	50 mA	5 s	DO NOT RESET!
2000	-50 mA	5 s	LESS THAN ±005

5.4 Instrument Calibration

A thorough check-out and adjustment of the Keithley Model 35035 mA/mAs Meter should be performed on a yearly basis. Three (3) trimmer potentiometers (accessible from the front side of the enclosure) are the only adjustments necessary to calibrate a properly functioning unit. The following 28 steps outline the calibration procedure:

1. With a fresh battery installed, remove the three (3) trimmer potentiometer access hole plugs. Remove any connections to the input terminals. Turn the Model 35035 FUNCTION switch to the mA position, the RANGE switch to the 200 position, and the MODE switch to the DC position.

2. Adjust the display zero trimmer potentiometer (R33) for a stable 00.0 display reading. The "-" polarity indicator on the display should flicker on and off.

3. Turn the Model 35035 FUNCTION switch to the mAs position, depress the mAs RESET button, and, if necessary, re-adjust the display zero trimmer potentiometer (R33) for a stable 00.0 display reading.

4. While alternately turning the FUNCTION switch between the mAs and mA positions, re-adjust the display zero trimmer potentiometer (R33) once again so that equal flicker of the "-" polarity indicator on the display is maintained between the two functions.

5. Connect the current source output to the Model 35035 input terminals.

6. Turn the Model 35035 FUNCTION switch to the mA position and ensure that the RANGE switch is set to the 200 position.

7. Alternately apply +190.0 mA and -190.0 mA to the Model 35035 input and adjust the mA gain trimmer potentiometer (R10) for equal readings on either side of 190.0 on the display.

8. Turn the Model 35035 RANGE switch to the 20 position.

9. Alternately apply +19.00 mA and -19.00 mA to the Model 35035 input and verify that its display reads between 18.95 and 19.05 and that the correct polarity is indicated.

10. Turn the Model 35035 RANGE switch to the 2000 position.

5.4 **Instrument Calibration** (continued)

11. Alternately apply +1900 mA and -1900 mA to the Model 35035 input and verify that its display reads between 1895 and 1905 and that the correct polarity is indicated.

12. Turn the Model 35035 FUNCTION switch to the mAs position and the RANGE switch to the 200 position.

13. Depress the Model 35035 RESET button.

14. Apply +100.0 mA for 1.9 seconds to the Model 35035 input and immediately adjust the mAs gain trimmer potentiometer (R7) for a reading of 190.0 on the display.

15. Depress the RESET button.

16. Apply -100.0 mA for 1.9 seconds to the Model 35035 input and immediately readjust the mAs gain potentiometer (R7) for a reading of -190.0 on the display.

17. Depress the RESET button.

18. Repeat steps 13 through 17 until equal readings on either side of 190.0 are attained on the Model 35035 display.

19. Turn the Model 35035 RANGE switch to the 2000 position.

20. Apply +1000 mA for 1.9 seconds to the Model 35035 input and verify that the display reads between 1895 and 1905.

21. Depress the RESET button.

22. Apply -1000 mA for 1.9 seconds to the Model 35035 input and verify that the display reads between -1895 and -1905. Before depressing the RESET button, verify that the display drifts no more than 5 display counts over a period of one minute.

23. Depress the RESET button.

24. Place the MODE switch in the AC position.

25. Again apply -1000 mA for 1.9 seconds to the Model 35035 input and verify that the display now reads between 1895 and 1905. This verifies correct operation of the front-end rectifier circuit in the Model 35035.

5.4 Instrument Calibration (continued)

26. Depress the RESET button, place the MODE switch back in the DC position, and turn the RANGE switch to the 20 position.

27. With the Model 35035 FUNCTION switch still in the mAs position, apply +100.0 mA to for 1.9 seconds to the input and verify that the display reads 0.00. This verifies lockout of the 20 range in the mAs function.

28. Turn the RANGE switch of the Model 35035 to the 2000 position and the FUNCTION switch to the OFF position. With the current source output turned off, remove the test leads from the Model 35035 input terminals. This concludes the adjustment and operational check-out of the meter.

5.5 Battery Replacement

The Model 35035 meter operates on a standard 9 V alkaline battery such as the Eveready 522. A appears in the display when the battery voltage reaches 7.2 V, indicating the battery needs to be replaced. The use of a battery type other than alkaline is not recommended.

WARNING

To avoid electrical shock, the instrument must be disconnected from the X-ray generator.

1. Turn the meter OFF and remove the test leads.

2. Turn the instrument over and remove the battery compartment cover.

3. Grasp the battery clip leads near the clip, gently lift the battery out of the compartment, and remove the old battery from the clip.

4. Install the new battery. Be certain that the clip end of the battery is inserted at the end of the compartment where the clip wires come out from the case and that the wires get looped around the top of the battery. This will aid the user the next time the battery needs to be replaced.

5. Re-install the battery compartment cover.

5.6 Fuse Replacement

The fuse is a standard 2 A, 250 V, 3AG, normal-blo Littlefuse 312002 or equivalent. Fuses or higher current rating must not be used.

WARNING

If the fuse has blown, the meter operation should be checked to ensure other damage has not occurred.

1. Turn the meter OFF and remove the test leads.

2. Place the end of a flat-blade screwdriver into the slot in the fuse holder. Press inward slightly and rotate the fuse carrier one-quarter turn counterclockwise. Release pressure and extract the fuse carrier and the fuse.

3. Remove the defective fuse and replace it with the new fuse.

4. Re-install the fuse carrier with the new fuse turning the carrier one-quarter turn clockwise into its holder.

5.7 Factory Service

To return the instrument to the factory for service, please photocopy and complete the service form which follows this section and return it with the instrument to:

Keithley Instruments, Inc.
31300 Bainbridge Road
Cleveland, Ohio 44139-2294
ATTN: Repair Department

KEITHLEY

1.0 PURPOSE:

To calibrate or verify the calibration of the Keithley Model 35035 mA/mAs meter to Engineering specifications.

2.0 EQUIPMENT:

Voltage/Current Source	Keithley Model 228, or equivalent voltage, and current source.
Programmable Current Source	Keithley Model 220, or equivalent current source.
Digital Multimeter	Keithley Model 175, or equivalent 4.5 digit DMM.
Test Fixture	TF-644, Input Polarity test fixture.
Display Extension Cable.	17 Pin Berg Cable assembly.
Data Sheet	CR-643

3.0 SETUP:

3.1 Disengage the 35035 display/top cover assembly and connect the Display Extension Cable between the PC board and the display on the top cover.

3.2 Make sure that the 228 (Voltage/Current Source) is in the STANDBY mode. Connect the output of the 228 to P1-1 with respect to P1-4 of the 35035. Program the 228 to output +9.00 volts @ +.1000 Amps.

3.3 Make sure that the AC/DC switch of the 35035 is set to the DC position.

4.0 POWER SUPPLY & DISPLAY ZERO:

4.1 Set the 228 to OPERATE, turn on the 35035, and set it to the 200 mA range and function.

4.2 Connect the 175 (DMM) to TP4 with respect to TP5. Set the 228 to OPERATE, and verify that the voltage at TP4 measures between +4.495 and +4.505 volts. Record the results on the data sheet.

4.3 Connect the 175 to TP6 with respect to TP5. Verify that the voltage at TP6 measures between -4.495 and -4.505 volts. Record the results on the data sheet.

4.4 Adjust R33 for a display of "00.0" in both the "mA" and "mAs" functions.

4.5 Place the 228 (Voltage/Current Source) in STANDBY, disconnect only the positive output connection of the 228 from P1-1 of the 35035.

4.6 Set the 175 (DMM) to the 20 mA range and function. Connect the 175 LO to P1-1 of the 35035 and the 175 HI lead to the positive output connection from the 228.

4.7 Set the 228 to OPERATE and verify that the current draw is between .750 and .850 mA. Record the measured current on the data sheet.

4.8 Decrease the output voltage of the 228 by .10 volts until the low battery symbol appears in the display of the 35035. Verify that the voltage (as displayed on the 228) required to illuminate the low battery symbol is between +7.00 and +7.40 volts.

4.9 If the low battery symbol voltage is not within stated specifications, adjust the "BAT" control located on the printed circuit board side of the display (digital panel meter). Record the final low battery voltage displayed on the 228 on the data sheet.

4.10 Place the 228 in STANDBY, disconnect the 228 and 175 from the battery input connector (P1) and re-connect the battery harness to the 35035.

5.0 THRESHOLD COMPARATOR VERIFICATION:

5.1 Set the 35035 to the 200 mAs range and function. Set the 175 to the 20 V range and function. Connect the output of the 228 to the female binding post of input test fixture (TF-644), positive to red binding post. Plug the test fixture into the input of the 35035.

5.2 Set the TX/BP switch of the test fixture to the BP position and the +/- switch to the "+" position. Program the 228 to output +10.00 volts @ .0025 Amps.

5.3 Press RESET, then measure and record the voltage at TP2 with respect to TP5. Verify that the measured voltage is in the range of -3.400 to -4.500 volts.

5.4 Connect the 175 to TP1 with respect to TP5. Increase the input current by .0001 A until the 35035 starts to integrate the input current.

5.5 Verify that the threshold reading (at TP1) is between +0.029 and +0.033 volts. Record the 175 reading on the data sheet. Measure and record the voltage at TP2 with respect to TP5.

5.6 Verify that the measured voltage is now in the range of +2.500 to +4.500 volts. Decrease the input current back to .0025 A. Record the reading on the data sheet.

5.7 Set the +/- switch of the test fixture to the "-" position. Press and release the RESET button of the 35035.

5.8 Increase the input current by .0001 A until the 35035 starts to integrate the input current. Verify that the threshold reading is between -0.029 and -0.033 volts. Record the 175 reading on the data sheet.

5.9 Place the 228 in STANDBY.

6.0 CURRENT FUNCTION CALIBRATION & VERIFICATION:

6.1 Set the 35035 to the 200 mA range and function. Program the 228 (Voltage/Current Source) to output +3.00 volts @ +0.190 Amps. Apply the input voltage and current.

6.2 Adjust R10 of the 35035 for a current reading between 189.9 and 190.1 mA. Alternately set the +/- switch of the test fixture between "+" and "-" to verify that the 35035 reads within 1 count of a reading equal in magnitude but opposite in polarity. Record the final setting on the data sheet. Place the 228 in STANDBY.

6.3 Program the 228 to output +3.00 volts @ +.0190 Amps and apply the input current. Set the 35035 to the 20 mA range.

6.4 Alternately set the +/- switch of the test fixture between "+" and "-" to verify that the 35035 reads between ±18.91 and ±19.09 mA. Record the displayed readings on the data sheet.

6.5 Set the 175 to the 20 mA range and function. Set the 228 to STANDBY and connect the test fixture to the input of the 175 (DMM). Set the 228 to OPERATE and record both polarities of the measured current on the data sheet.

6.6 Switch the 175 to the 2000 mA range. Program the current source to output +3.00 volts @ +01.90 Amps and apply the input current. Record both polarities of the measured current on the data sheet. Place the 228 in STANDBY.

6.7 Set the 35035 to the 2000 mA range and function. Connect the test fixture to the input of the 35035. Set the 228 (Voltage/Current Source) to OPERATE and allow the 35035 reading about 30 seconds to stabilize.

6.8 Set the 228 to STANDBY and the +/- switch of the test fixture to "-", set the 228 to OPERATE and record the measured reading on the data sheet.

6.9 Place the 228 in STANDBY and use the formula shown below to calculate and record the error between the 35035 and the 175 (DMM). Verify that the calculated error does not exceed ±.5%.

$$\% \text{ Error} = \left[\frac{(\text{mAs} - \text{DMM})}{\text{DMM}} \right] \times 100$$

7.0 mAs CALIBRATION & VERIFICATION:

7.1 Disconnect the output of the 228 from the test fixture. Connect the output of the 220 (Programmable Current Source) to the triax input of the test fixture. Set the TX/BP switch of the test fixture to the TX position.

7.2 Program the 220 to output 100 mA for 1.9 seconds. Set the 35035 to the 200 mAs range and function. Press the RESET button to zero the 35035 display.

7.3 Apply the timed input current. After the timed input current is terminated, adjust R7 for a displayed reading between 189.9 and 190.1 mAs.

7.4 Reset the display and alternately set the +/- switch of the test fixture between "+" and "-" then repeat the previous step until the 35035 no longer needs adjusting.

7.5 Verify that the 35035 reads within 1 count of a reading equal in magnitude but opposite in polarity. Record the final adjusted reading for both positive and negative timed input current values.

AC Input Operation

7.6 Set the AC/DC switch of the 35035 to the AC position and apply the timed input current. Verify that the 35035 gives only positive readings for a negative or positive timed input current value.

7.7 Reset the 35035 display and switch the AC/DC switch back to DC. Check off the results on the data sheet.

7.8 Set the 35035 range switch to the 20 range. Press RESET on the 35035 and apply the timed input current of step 7.2 and verify that the 35035 does not register a reading. Check off the results on the data sheet.

7.9 Set the 35035 to the 2000 mAs range. Program the 220 (Programmable Current Source) to output 100 mA for 19 seconds. Press the RESET button to zero the 35035 display.

7.10 Apply the timed input current. Verify that after the input current is terminated, the 35035 reads between 1891 and 1909 mAs.

7.11 Repeat the previous step with the +/- switch of the test fixture set to the opposite polarity. After the input current is terminated, DO NOT RESET THE 35035 DISPLAY.

Display Drift

7.12 Verify that the 35035 does not change by more than 5 counts in any 60 second interval. Record the results on the data sheet.

7.13 Set the 35035 to the 2000 mA range and function. Disconnect the test fixture from the input of the 35035.

7.14 Disconnect the output of the 220 from the input of the test fixture. Set the TX/BP switch to the BP position.

7.15 Turn off the 35035, sign and date the data sheet and history card, and pass to Quality Assurance for inspection.

37542 C

ZONE	LTR	ECO NO	REVISION	ENG	DATE
	A	570	RELEASE TO MFG.	RG	1-15-90

FU-13 2A F1
HI
LO
R15 V130LA10A
RF-64 D1
SW3
E112-5-D1-V80-B-E
D2 1N5359
D3 1N5359
SW2/A 1 2000 2 200 3 20
R1 KMN350-90.252
R2 KMN350-9.026
R3 KMN350-1.003
* = -.25% ABSOLUTE, 0.1% MATCHING (4V)
SW1/A 1 OFF 2 mA 3 mAs
SW2/B 4 2000 5 200 6 20
SW1/B 4 OFF 5 mA 6 mAs
SW1/C 7 OFF 8 mA 9 mAs
SW1/D 10 OFF 11 mA 12 mAs
R4 R-76-4.7K
C1 C-413-100
BA1
R5 R-88-100K
R6 R-88-806K
R7 3299Z-204 200K CW
R8 R-88-100K
R9 R-88-806K
R10 3299Z-204 200K CW
MTR_VDD
MTR_DP3
MTR_DP2
MTR_RFH
MTR_ROH
MTR_RFL
MTR_COM
MTR_ROL
MTR_VSS
MTR_INLO
MTR_INHI
MTR_REFBG
C-64-100P C11
C-237-.1 C10
C-413-100 C12
U4 ICL7660 VIN OSC C+ LV C- VOUT GND
R27 R-76-1M
C14 C-413-100
C13 C-237-.1
TP4 TP5 TP6

C-237-.1 C6 U2 CD4027B
C-237-.1 C9 U3 LT1078
U2/B CD4027B
D4 1N914
D5 1N914
R12 R-76-1M
R13 R-76-1M
TP1
R11 R-88-100K
Q1 2N4338
Q2 2N4338
C2 10UF
C15 C-237-.1
U1 LT1012
R30 R-76-100K
C4 C-237-.1
R18 R-76-220K
U3/B LT1078
D11 1N914
D6 1N914
D7 1N914
C7 C-64-100P
D8 LM385-1.2
R24 R-88-953K
R21 R-76-1M
R14 R-76-47K
TP2
R32 R-88-100K
R23 R-76-47K
R25 R-88-23.2K
R31 R-76-22M
R33 RP-124-10K CW
R34 R-88-100K
C8 C-64-100P
R19 R-88-953K
U3/A LT1078
D12 1N914
R20 R-88-23.2K
R28 R-88-499K
R22 R-76-6.8M
R29 R-88-10K
R26 R-76-220K
D9 1N914
D10 1N914
TP3
SW4 1 2 3
R16 R-76-100K
R17 R-76-470
C5 C-237-1
U2/A CD4027B
VDD
VSS

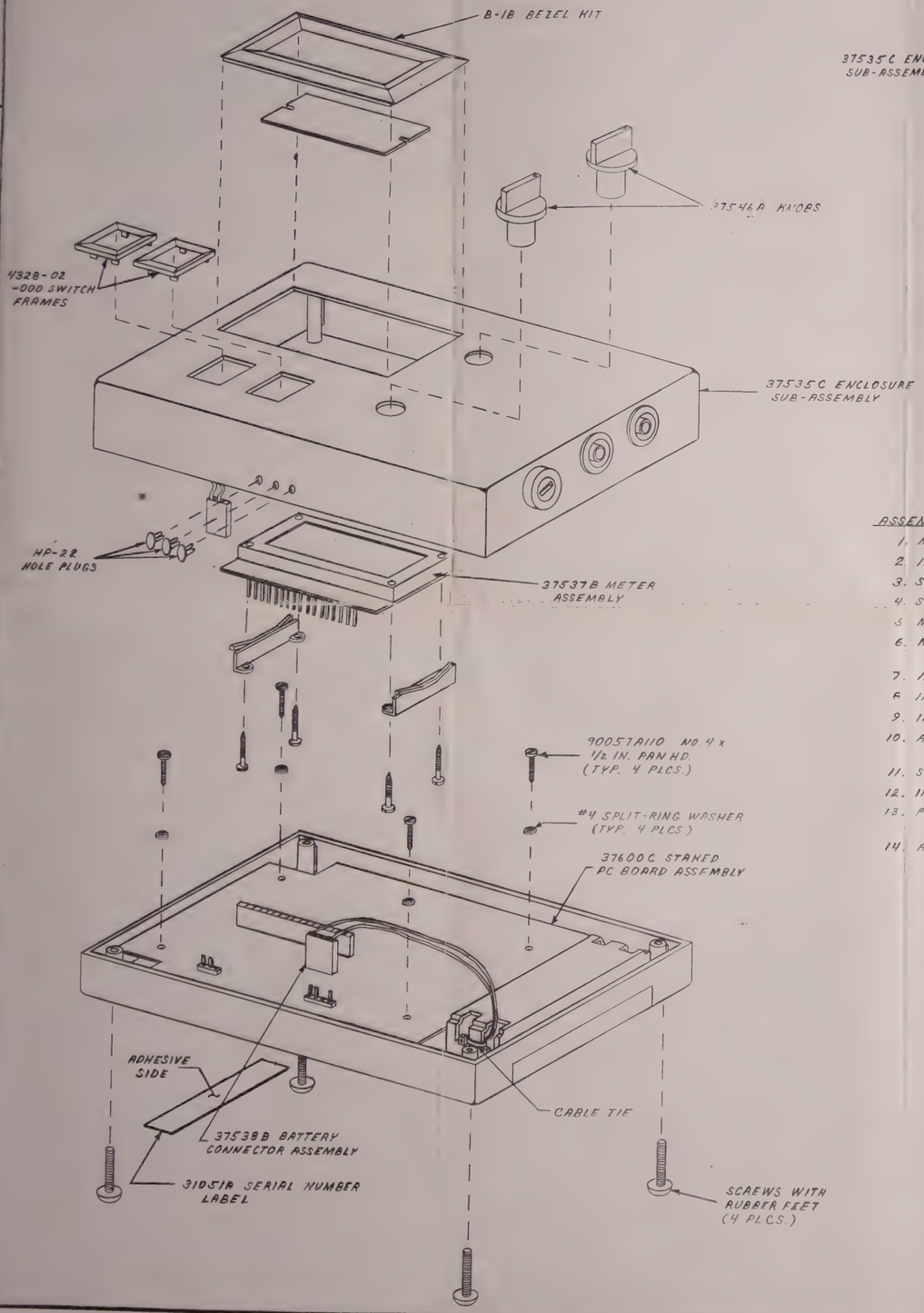
35035 MODEL | NEXT ASSEMBLY | QTY. USED ON

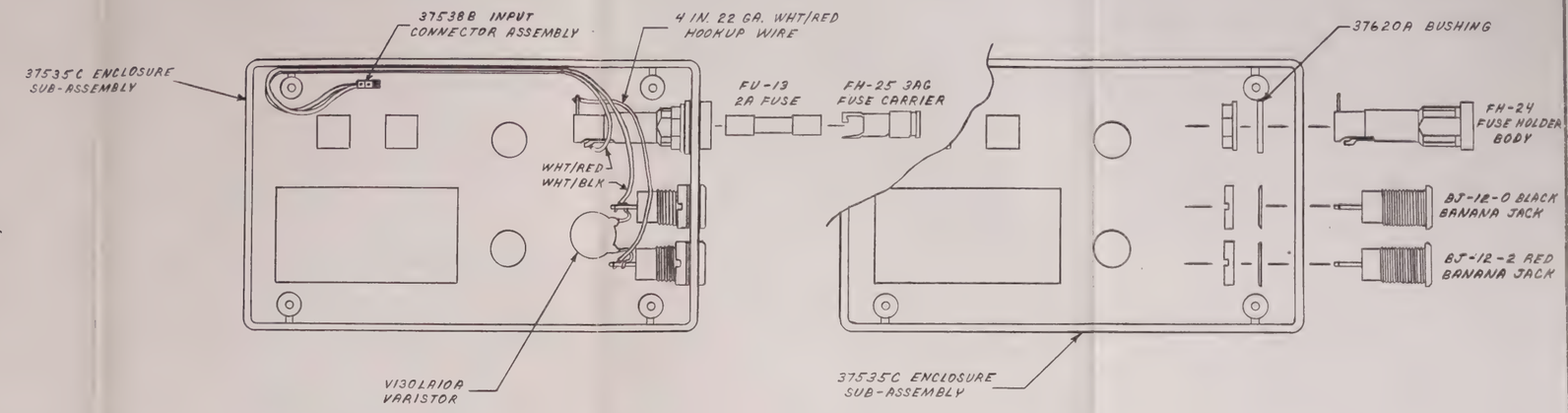
DO NOT SCALE THIS DRAWING
DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED
XX = ± .015 ANG = ±1°
XXX = ± .005 FRAC = ±1/64
SURFACE MAX 63
DATE 8-89 DRN CMCF ENG APPR.
SCALE
MATERIAL
FINISH
TITLE MAS METER SCHEMATIC
KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139
D NO. 37542

FORM 28511D REV. D

375410 ON

ZONE	LTR	ECO NO	REVISION	ENG	DATE
	A	570	RELEASE TO MFG.	RB	1-19-10


B-1B BEZEL KIT
37546A KNOBS
4328-02-000 SWITCH FRAMES
37535C ENCLOSURE SUB-ASSEMBLY
HP-28 HOLE PLUGS
37537B METER ASSEMBLY
90057A110 NO. 4 x 1/2 IN. PAN HD. (TYP. 4 PLCS.)
#4 SPLIT-RING WASHER (TYP. 4 PLCS.)
37600C STAKED PC BOARD ASSEMBLY
ADHESIVE SIDE
CABLE TIE
37538B BATTERY CONNECTOR ASSEMBLY
3105IA SERIAL NUMBER LABEL
SCREWS WITH RUBBER FEET (4 PLCS.)



ASSEMBLY PROCEDURE:

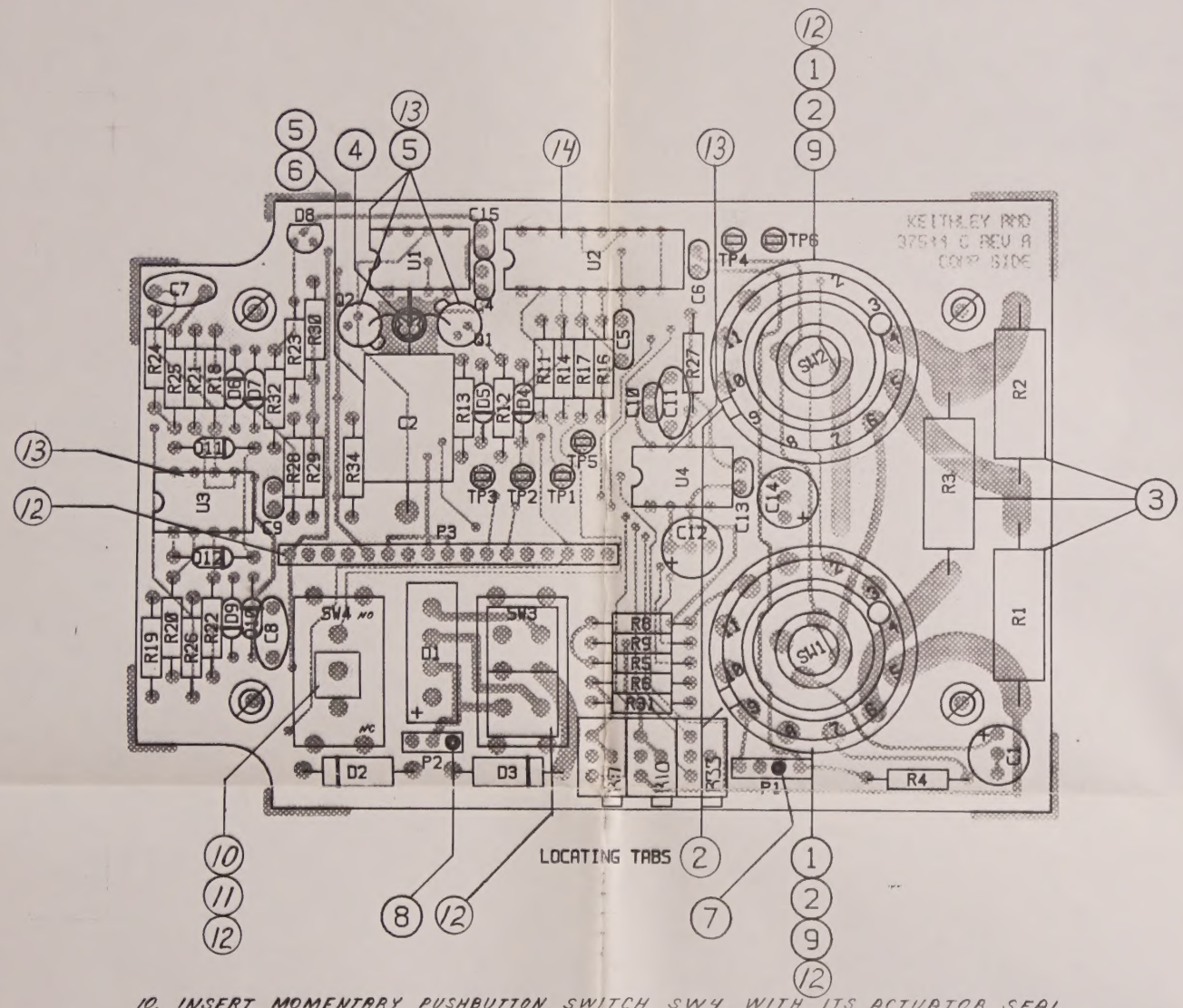
1. MOUNT FUSE HOLDER BODY FH-24 AND BANANA JACKS BJ-12-0 AND BJ-12-2 INTO ENCLOSURE SUB-ASSEMBLY 37535C.
2. INSTALL THE FH-25 FUSE CARRIER AND FU-13 FUSE INTO THE FUSE HOLDER BODY.
3. SOLDER THE V130LA10A VARISTOR AND THE 4-INCH 22-GA. WHT/RED WIRE INTO PLACE.
4. SOLDER THE 37538B INPUT CONNECTOR ASSEMBLY INTO PLACE AND DRESS THE WIRING AS SHOWN.
5. MOUNT THE 4328-02-000 SWITCH FRAMES INTO THE 37535C ENCLOSURE SUB-ASSEMBLY.
6. MOUNT THE 37537B METER ASSEMBLY WITH THE B-1B BEZEL KIT (INCLUDES THE METER BEZEL, WINDOW, TWO BRACKETS, AND FOUR SCREWS) INTO THE 37535C ENCLOSURE SUB-ASSEMBLY.
7. INSTALL THE 37538B BATTERY CONNECTOR ASSEMBLY SECURING IT TO THE ENCLOSURE BOTTOM WITH A CABLE TIE AS SHOWN.
8. INSTALL THE 37600C PC BOARD ASSEMBLY INTO THE ENCLOSURE BOTTOM SECURING IT WITH FOUR NO. 4 TYPE B PAN HEAD SCREWS.
9. INSERT THE BATTERY AND INPUT CONNECTOR RECEPTACLES INTO THEIR RESPECTIVE PLUGS ON THE PC BOARD.
10. ALIGN THE CONNECTOR RECEPTACLE ON THE 37537B METER ASSEMBLY WITH ITS MATING CONNECTOR PLUG ON THE 37600C PC BOARD ASSEMBLY AND CAREFULLY PRESS THE TOP AND BOTTOM ENCLOSURE PARTS TOGETHER.
11. SECURE THE TOP AND BOTTOM ENCLOSURE PARTS TOGETHER USING THE FOUR 6-32 FLAT-HEAD SCREWS AND FOUR RUBBER FEET THAT COME WITH EACH ENCLOSURE.
12. INSTALL THE 37546A KNOBS SUCH THAT THEY ARE FULLY SEATED ON THE ROTARY SWITCH SHAFTS.
13. PREVIOUS TO SENDING COMPLETED ASSEMBLY TO TECH AREA FOR TEST AND CALIBRATION, ENSURE THAT BOTH ROTARY SWITCHES ARE IN THEIR FULL COUNTER-CLOCKWISE POSITIONS.
14. AFTER UNIT IS ASSEMBLED INSTALL THE 3105IA SERIAL TAG (MODEL AND SERIAL NUMBERS TYPED/REGISTERED) ONTO THE BACK OF THE ENCLOSURE BOTTOM SO THAT IT CAN BE READ WHEN VIEWING THE BACK WITH THE BATTERY COMPARTMENT IN THE DOWN POSITION.

35035	37534 PC	1
MODEL	NEXT ASSEMBLY	QTY
USED ON		

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 9/13/89	SCALE 1/1	TITLE FINAL ASSEMBLY
KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139	XX = ± .015 ANG = ±1°	DRN D.C.	ENG APPR.	
	XXX = ± .005 FRAC = ±1/64	MATERIAL SEE DRAWING		
	SURFACE MAX. 63	FINISH		D NO. 37541D

375456 ON

ZONE	LTR	ECO NO.	DESCRIPTION	APP'D	DATE
	A	570	RELEASE TO MFG.	RW	1-19-90



NOTES

1. INSERT SWITCH BASE ONLY OF SW1 AND SW2 INTO PC BD FOR WAVE SOLDERING. DO NOT BEND TERMINALS. SWITCHES TO BE ASSEMBLED ONTO BASES AFTER SOLDERING
2. POSITION SWITCH BASES OF SW1 AND SW2 SO THAT LOCATING TABS ARE POSITIONED AS SHOWN.
3. MOUNT R1, R2, AND R3 1/32"-1/16" ABOVE PC BD SURFACE BEFORE SOLDERING. (SPACE ALLOWS FOR HEAT DISSAPATION AND ALSO MAINTAINS THE REQUIRED 3/8" LEAD LENGTH FROM END OF HIGH PRECISION RESISTOR TO PC BD CIRCUITRY).
4. STAKE TE-79 CLOVERLEAF TERMINAL INTO COUNTER-SUNK HOLE FROM COMP SIDE OF PC BD.
5. CONNECT PIN 2 OF U1, SOURCE LEAD OF Q1, SOURCE LEAD OF Q2, AND LEAD OF C2 INTO TE-79 TERMINAL.
6. MOUNT C2 1/32"-1/16" ABOVE PC BD SURFACE BEFORE SOLDERING.
7. CUT OFF PIN 3 OF P1 (INDICATED WITH ⊙)
8. CUT OFF PIN 3 OF P2 (INDICATED WITH ⊙)
9. ASSEMBLY INSTRUCTIONS FOR SW1 AND SW2:
   A. REMOVE AND DISCARD PROTECTIVE CAP OFF HOUSING/SHAFT ASS'Y.
   B. DO NOT PUSH ON SWITCH SHAFT. DETENT MECHANISM WILL COME APART.
   C. HOLDING SWITCH HOUSING, ALIGN LOCATING TAB ON BASE WITH WITH NOTCH ON HOUSING, AND ENGAGE 4 HOUSING LATCHES IN SLOTS ON BASE.
   D. PUSH FIRMLY ON HOUSING UNTIL LATCHES SNAP IN PLACE.
   E. REMOVE CLIP FROM SHAFT AND DISCARD.
10. INSERT MOMENTARY PUSHBUTTON SWITCH SW4 WITH ITS ACTUATOR SEAL INCLUDED FOR WAVE SOLDERING. MAKE CERTAIN THAT THE "NC" AND "NO" MARKINGS ON THE SWITCH CORRESPOND WITH THOSE ON THE PC BOARD.
11. AFTER WAVE SOLDERING, REMOVE THE ACTUATOR SEAL AND INSTALL THE SWITCH CAP (C&K PART NO. 7982-02-000) ONTO THE PUSHBUTTON ACTUATOR.
12. EXTREME CARE MUST BE EXERCISED TO ENSURE THAT P3, SW1, SW2, SW3, AND SW4 ARE FIRMLY SEATED FLUSH AND PRECISELY PERPENDICULAR TO THE SURFACE OF THE PC BOARD PRIOR TO AND AFTER SOLDERING.
13. U1, U3, AND U4 TO BE INSTALLED IN SO-72 8-PIN DIP SOCKETS.
14. U2 TO BE INSTALLED IN AN SO-65 16-PIN DIP SOCKET.

MODEL	NEXT ASSEMBLY	QTY
35035	37600C	1

USED ON

DO NOT SCALE THIS DRAWING	DIMENSIONAL TOLERANCES UNLESS OTHERWISE SPECIFIED	DATE 9/18/89	SCALE 2X	TITLE ASSEMBLY, PC BOARD
KEITHLEY Keithley Instruments Inc. Cleveland, Ohio 44139	XX = ±.015 ANG. = ±1°	DRN. D.C.	ENG APPR.	
	XXX = ± .005 FRAC. = ±1/64	MATERIAL		NO. 37545C
	SURFACE MAX. 63	FINISH		C

FORM 30152C REV. D

MP MASTER
MA31400